Motor device having commutator and brushes located outside the yoke and within a gear housing

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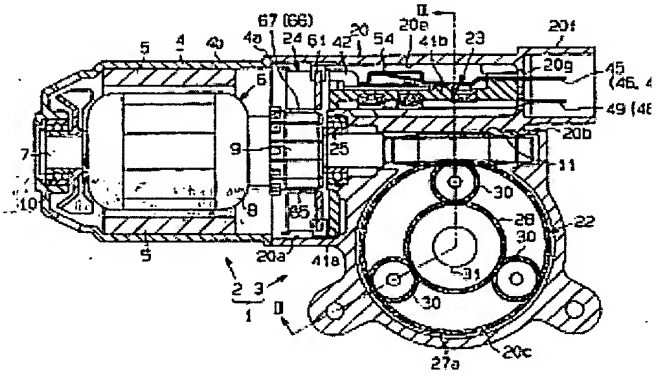
Abstract of **EP1137153**

A motor device (1) comprises a motor unit (2) and a reduction unit (3). The motor unit (2) comprises a yoke (4) which is formed in a generally bottomed cylindrical shape, and a rotor (6) having an armature (8) and a rotary shaft (7). The reduction unit (3) comprises a gear housing (20) accommodating a reduction gear device (22) for producing an output after reducing rotational speed of the rotor (6) and fixed to the opening of the yoke (4). A commutator (9) and brushes (65 - 67, 81, 82, 84 - 87) for the motor unit (2) are disposed in the gear housing (20) which is provided outside the opening of the yoke (4) in the axial direction of the rotary shaft (7). The gear housing (20) has a flange (20, 83, 88) formed in a square shape, and the brushes (65 - 67, 81, 82, 84 - 87) are arranged along the diagonal lines of the square shape.

FIG. 1



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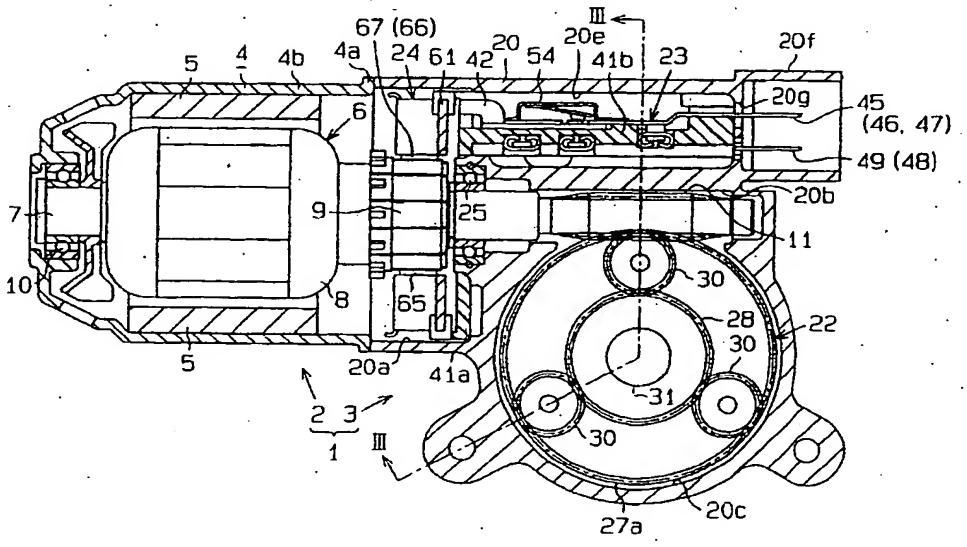
(54) Motor device having commutator and brushes located outside the yoke and within a gear housing

(57) A motor device (1) comprises a motor unit (2) and a reduction unit (3). The motor unit (2) comprises a yoke (4) which is formed in a generally bottomed cylindrical shape, and a rotor (6) having an armature (8) and a rotary shaft (7). The reduction unit (3) comprises a gear housing (20) accommodating a reduction gear device (22) for producing an output after reducing rotational speed of the rotor (6) and fixed to the opening of the yoke (4). A commutator (9) and brushes (65 - 67, 81, 82, 84 - 87) for the motor unit (2) are disposed in the gear housing (20) which is provided outside the opening of the yoke (4) in the axial direction of the rotary shaft (7). The gear housing (20) has a flange (20, 83, 88) formed in a square shape, and the brushes (65 - 67, 81, 82, 84 - 87) are arranged along the diagonal lines of the square shape.

FIG. 1



choke coils 50, 51 and the circuit breaker 54 are arranged in parallel on the central part of the insertion plate 41b in such a manner that the choke coils 50, 51 sandwiches the circuit breaker 54. The external terminals 45 - 47 are arranged so that the respective terminals thereof protrude from top ends. The brush wiring terminal 42 for common connection to the ground is connected to the external terminal 45 through the circuit breaker 54. The brush wiring terminal 43 for connection to the high voltage power source for high speed operation is connected to the external terminal 46 through the choke coil 50. The brush wiring terminal 44 for connection to the high voltage power source for high speed operation is connected to the external terminal 47 through the choke coil 51.

[0022] Two external terminals 48, 49 are mounted on the bottom surface of the insertion plate 41b. The external terminals 48, 49 are arranged in parallel so that respective ends at one side protrude from the top end of the insertion plate 41b. The external terminals 48, 49 are provided to output detection signals of a rotation sensor (not shown).

[0023] As shown in Fig. 1, the circuit unit 23 is fixed in such a manner that the insertion plate 41b is inserted into the circuit accommodating chamber 20e and the disk 41a is inserted into the brush accommodating recess 20a. The top ends of the external terminals 45 -49 passe through the communication hole 20g and protrude into the connector body 20f, thus forming pins of the connector.

[0024] The brush accommodating recess 20a accommodates therein a brush holding unit 24. Specifically, as shown in Fig. 4, the brush holding unit 24 has a plate 61, three brush holders 62 - 64, three brushes 65 - 67 and three helical torsion springs 68 - 70.

[0025] The plate 61 is formed in a generally square shape to be accommodated within the brush accommodating recess 20a. The plate 61 formed with a central hole 61a in its center and cut-outs 61b, 61c at its outer peripheral ends while avoiding the capacitors 52, 53. Three brush holders 62 - 64 are fixed on the top surface of the plate 61. Each brush holder 62 - 64 supports respective brushes 65 - 67. The brush holders 62 - 64 and the brushes 65 - 67 are arranged generally along diagonal lines of the generally square-shaped plate 61.

[0026] In this embodiment, the brushes 65, 67 are arranged to oppose each other with respect to the center of the plate 61, and the brush 66 is disposed at a location which is 70° spaced apart from the brush 67. The brush holder 62 and the brush 65 are for connection to the common ground, the brush holder 63 and the brush 66 are for connection to the high voltage power source for high speed operation, and the brush holder 64 and the brush 67 are for connection to the high voltage power source for low speed operation. Pins P are provided on the plate 61 near brush holders 62 - 64 in the counterclockwise direction, respectively. The brushes 65 - 67 are biased towards the commutator 9 (shown with two-dot chain line in Fig. 4) by the helical torsion springs 68 - 70, respectively.

[0027] The brush holder unit 24 is accommodated in the brush accommodating recess 20a in parallel with the disk 41a of the circuit unit 23. Pig tails 65a - 67a of the brushes 65 - 67 are connected to corresponding connecting terminals 42a - 44a, respectively. Each brush 65 - 67 is located outside the opening of the yoke 4 in the axial direction of the rotary shaft 7 together with the commutator 9.

[0028] As shown in Fig. 4, each brush 65 - 67 extends closely to the inner periphery (shown with two-dot chain line in Fig. 4) 4d of the yoke 4. The helical torsion springs 68 - 70 are partly disposed outside the inner periphery 4d in the radial direction. The capacitors 52, 53 are not in contact with the plate 61 under this condition due to the cut-outs 61b, 61c, and protrude above the plate 61. The capacitors 52, 53 are partly disposed outside the inner periphery 4d of the yoke 4 in the radial direction.

[0029] As shown in Fig. 3, the cover 21 is fixed to the opening of the wheel accommodating chamber 20c of the gear housing 20. A connector of an electronic motor control circuit device (not shown) is connected to the connector of the motor device 1, that is, the connector body 20f and the top ends of the external terminals 45 - 49.

[0030] In the motor device 1 constructed as above, the armature 8 generates magnetic field to rotate the rotor 6, when a direct current voltage is applied from the control circuit device to the external terminal 45, 47. The rotor 6 rotates at high speeds, when the direct current voltage is applied from the control circuit device to the external terminals 45, 46.

[0031] Electrical noises occur during this rotation, because the brushes 65, 67 (65, 66) slidingly contact the commutator 9. These electrical noises are suppressed by the inductance of the choke coil 51 (50) and the capacitance of the capacitor 53 (52). As a result, transmission of the electrical noises to the external control circuit device is suppressed, and radiation of electromagnetic noises arising from the electrical noises is restricted.

[0032] Further, the choke coil 51 (50) generates heat, when the winding of the armature 8 generates heat due to excessive current during rotation of the rotor 6, for instance, when a heavy load is applied to the side of the output shaft 31. The circuit breaker 54 is turned into a disconnection condition in accordance with the generated heat of the choke coil 51 (50), so that no more excessive current is supplied. Thus, burnout due to heat generation is prevented.

[0033] The first embodiment provides the following advantages.

(1) The commutator 9 and the brushes 65 - 67 are disposed outside the opening of the yoke 4, which is formed in a bottomed, generally cylindrical shape, in the axial direction of the rotary shaft 7. Thereby, the brushes 65 - 67 can be disposed without being

restricted by the inner periphery 4d of the yoke 4. As a result, the length of the brushes can be increased to prolong life of the brushes. Further, members which are disposed on the same plane in the axial direction as the brushes 65 - 67, for instance, the helical torsion springs 67 - 70 which bias the brushes 65 - 67 towards the central axis side of the yoke 4, can also be disposed without being restricted by the inner periphery 4d of the yoke 4.

(2) The brushes 65 - 67 are arranged generally along the diagonal lines in the brush accommodating chamber 20a which is formed at the side end of the yoke 4 of the gear housing 20 and formed in a generally square shape when viewed in the axial direction of the rotary shaft 7. As a result, the length of the brushes can be maximized within the brush accommodating chamber 20a.

(3) The length of each side of the brush accommodating recess 20a is set to be generally equal to the diameter of the cylindrical part 4b of the yoke 4. As a result, the length of the brushes can be increased without sizing entirety of the motor device large.

(4) The opening of the brush accommodating chamber 20a is covered with the flange 4a which is formed at the opening side of the yoke and in a generally square shape when viewed in the axial direction of the rotary shaft. As a result, no additional member is required to cover the opening of the brush accommodating chamber 20a formed in a generally square shape when viewed in the axial direction of the rotary shaft 7.

(5) The capacitors 52, 53 are accommodated in the brush accommodating chamber 20a with parts thereof being disposed outside the inner periphery 4d of the yoke 4. As a result, space required for accommodating the capacitors 52, 53 is provided sufficiently, and no space is required at other locations.

(Second Embodiment)

[0034] In this embodiment, the motor device 1 has two brushes 81, 82 as shown in Fig. 7. Specifically, the yoke-side end of a gear housing 83 is formed in a generally square shape when viewed in the axial direction of the rotary shaft 7 in the same manner as in the gear housing 20. This end is formed with a brush accommodating recess 83a formed in a generally square shape when viewed in the axial direction of the rotary shaft 7. Further, as the housing-side engagement parts, female threads 83b are formed in the two opposing corners at the yoke-side end of the gear housing 83.

[0035] The two brushes 81, 82 are arranged at the other corners where the female threads 83b are not formed along the generally diagonal lines in the brush accommodating chamber 83a. In this instance, the screw holes 4c of the yoke 4 need to be provided only in the two corners which correspond to the female threads 83b. The screw holes 4c function as the yoke-side engagement parts in this modification. Thus, the gear housing 83 is fixed to the yoke 4 by threading screws into the female threads 83b through the thread holes 4c.

[0036] In this second embodiment, the advantages (1) - (4) of the first embodiment can be provided similarly. In addition, because the gear housing 83 and the yoke 4 are fixed to each other at the part of the female threads 83b formed in the two corners of the gear housing 83 where the brushes 81, 82 are not disposed, the gear housing 83 and the yoke 4 can be fixed with ease while ensuring a sufficient space for arranging the brushes 81, 82.

(Third Embodiment)

[0037] In this embodiment, the motor device 1 has four brushes 84 - 87 as shown in Fig. 8. Specifically, the yoke-side end of a gear housing 88 is formed in a generally square shape when viewed in the axial direction of the rotary shaft 7 in the same manner as in the gear housing 20. This end is formed with a brush accommodating recess 88a formed in a generally square shape when viewed in the axial direction of the rotary shaft 7. The four brushes 84 - 87 are arranged at the corners along the generally diagonal lines in the brush accommodating chamber 83a.

[0038] In this third embodiment, the advantages (1) - (4) of the first embodiment can be provided similarly.

[0039] The above embodiments may be modified or altered as follows.

[0040] The number of the brushes may be only one, as long as it is arranged along the generally diagonal line in the brush accommodating recess 20a. According to this modification, the life of brush can be increased as well by increasing the length of the at least one of the brushes.

[0041] The length of each side of the brush accommodating recess 20a need not be generally the same as the diameter of the cylindrical part of the yoke 4. For instance, the length of the brush can be made further longer by sizing the length of each side of the brush accommodating recess 20a to be longer than the diameter of the cylindrical part 4b of the yoke 4. Even if the length of each side of the brush accommodating recess 20a to be shorter than the diameter of the cylindrical part 4b of the yoke 4, the entire size of the motor can be reduced while maintaining the same brush length as in the conventional one.

[0042] The brush accommodating recess 20a may be formed in other shapes as long as it is at least partially larger than the inner periphery of the yoke 4 in the radial direction. For instance, the brush accommodating recess 20a may be formed in a shape which is generally circular but extends in the radial direction only at locations where the brushes are arranged when viewed in the direction of the rotary shaft 7. In this modification as well, the length of the brush can be increased to prolong

the life of the brush.

[0043] The capacitors 52, 53 may be positioned at different locations. In this modification as well, the advantages (1) - (4) of the first embodiment can be provided similarly.

[0044] Noise-suppressing circuit elements other than the capacitors 52, 53, that is, choke coils 50, 51, may be disposed outside the inner periphery 4d of the yoke 4 in the radial direction while being disposed at least partially in the brush accommodating chamber 20a. Further, the circuit breaker 54 may be disposed outside the inner periphery of the yoke 4 in the radial direction while being disposed at least partially in the brush accommodating recess 20a. This arrangement ensures a sufficient space for the circuit breaker 54, and no additional space need be provided at other locations.

[0045] The helical torsion springs 68 - 70 in the above embodiment may be modified to compression coil springs 89 as shown in Figs. 7 and 8. In this modification, the brushes 81, 82, 84 - 87, and the compression coil springs 89 can be disposed without being restricted by the inner periphery 4d of the yoke 4.

[0046] A motor device (1) comprises a motor unit (2) and a reduction unit (3). The motor unit (2) comprises a yoke (4) which is formed in a generally bottomed cylindrical shape, and a rotor (6) having an armature (8) and a rotary shaft (7). The reduction unit (3) comprises a gear housing (20) accommodating a reduction gear device (22) for producing an output after reducing rotational speed of the rotor (6) and fixed to the opening of the yoke (4). A commutator (9) and brushes (65 - 67, 81, 82, 84 - 87) for the motor unit (2) are disposed in the gear housing (20) which is provided outside the opening of the yoke (4) in the axial direction of the rotary shaft (7). The gear housing (20) has a flange (20, 83, 88) formed in a square shape, and the brushes (65 - 67, 81, 82, 84 - 87) are arranged along the diagonal lines of the square shape.

Claims

1. A motor device (1) comprising:

   a yoke (4) formed generally in a bottomed cylindrical shape;
   a rotor (6) in which an armature (8) and a commutator (9) are fixed to a rotary shaft (7) and which is generally accommodated in the yoke (4);
   brushes (65-67, 81, 82, 84-87) force-contacted to the commutator (9); and
   a gear housing (20, 83, 88) accommodating a reduction member (22) which produces output after reducing a rotation speed of the rotor (6), and fixed in an opening of the yoke (4),
   wherein the commutator (9) and the brushes (65-67, 81, 82, 84-87) are disposed within the gear housing (20, 83, 88) which is located outside the opening of the yoke (4) in an axial direction of the rotary shaft (7).

2. The motor device (1) as in claim 1, wherein:

   a brush accommodating recess (20a, 83a, 88a) is formed in the gear housing (20, 83, 88) at an end on a side of the yoke (4), the recess (20a, 83a, 88a) being larger at least partly than an inner periphery (4d) of the yoke (4) in a radial direction; and
   the brushes (65-67, 81, 82, 84-87) are disposed within the brush accommodating recess (20a, 83a, 88a) to extend in a space which is larger than the inner periphery (4d).

3. The motor device (1) as in claim 2, wherein:

   the brush accommodating recess (20a, 83a, 88a) is formed generally in a square shape when viewed in the axial direction of the rotary shaft (7); and
   the brushes (65-67, 81, 82, 84-87) are disposed generally along a diagonal line in the brush accommodating recess (20a, 83a, 88a).

4. The motor device (1) as in claim 3, wherein:
   the yoke (4) is formed with a flange (4a) around the opening of the yoke (4) so that the flange (4a) covers an opening of the brush accommodating recess (20a, 83a, 88a), the flange (4a) being generally in the square shape when viewed in the axial direction of the rotary shaft (7).

5. The motor device (1) as in claim 4, wherein:

   the brushes (81, 82) are disposed at two opposing corners of the brush accommodating recess (83a), respectively;
   housing-side fitting parts (83b) are formed at two corners of the yoke-side end the gear housing (83), respectively, where the brushes (81, 82) are not disposed;
   yoke-side fitting parts (4c) are formed at two opposing corners of the flange (4a) respectively; and
   the gear housing (83) and the yoke (4) are fixed to each other by the housing-side fitting parts (83b) and the yoke-side fitting parts (4c).

6. A motor device (1) comprising:

   a motor unit (2) having a cylindrical yoke (4) formed with a flange (4a) at one end thereof, a rotary shaft (7) rotatably supported in the yoke (4) and extending outward through the flange (4a) in an axial direction;

a reduction unit (3) having a housing (20, 83, 88) formed with a flange (20a) coupled with the flange (4a) of the yoke (4) and accommodating a reduction device (22) engaged with the rotary shaft (7), the flange (20a) of the reduction unit (3) providing a generally square-shaped recess (20a, 83a, 88a) radially inside threreof;
a cylindrical commutator (9) fixed to the rotary shaft (7) in the recess (20a, 83a, 88a); and
a brush (65 - 67, 81, 82, 84 -87) disposed in the recess (20a, 83a, 88a) and biased to contact the commutator (9) along a diagonal line of the recess (20a, 83a, 88a).

7. The motor device (1) as in claim 6, wherein:
the recess (20a, 83a, 88a) has four sides each of which is in generally the same length as a diameter of the yoke (4).

8. The motor device (1) as in claim 6 or 7, wherein:

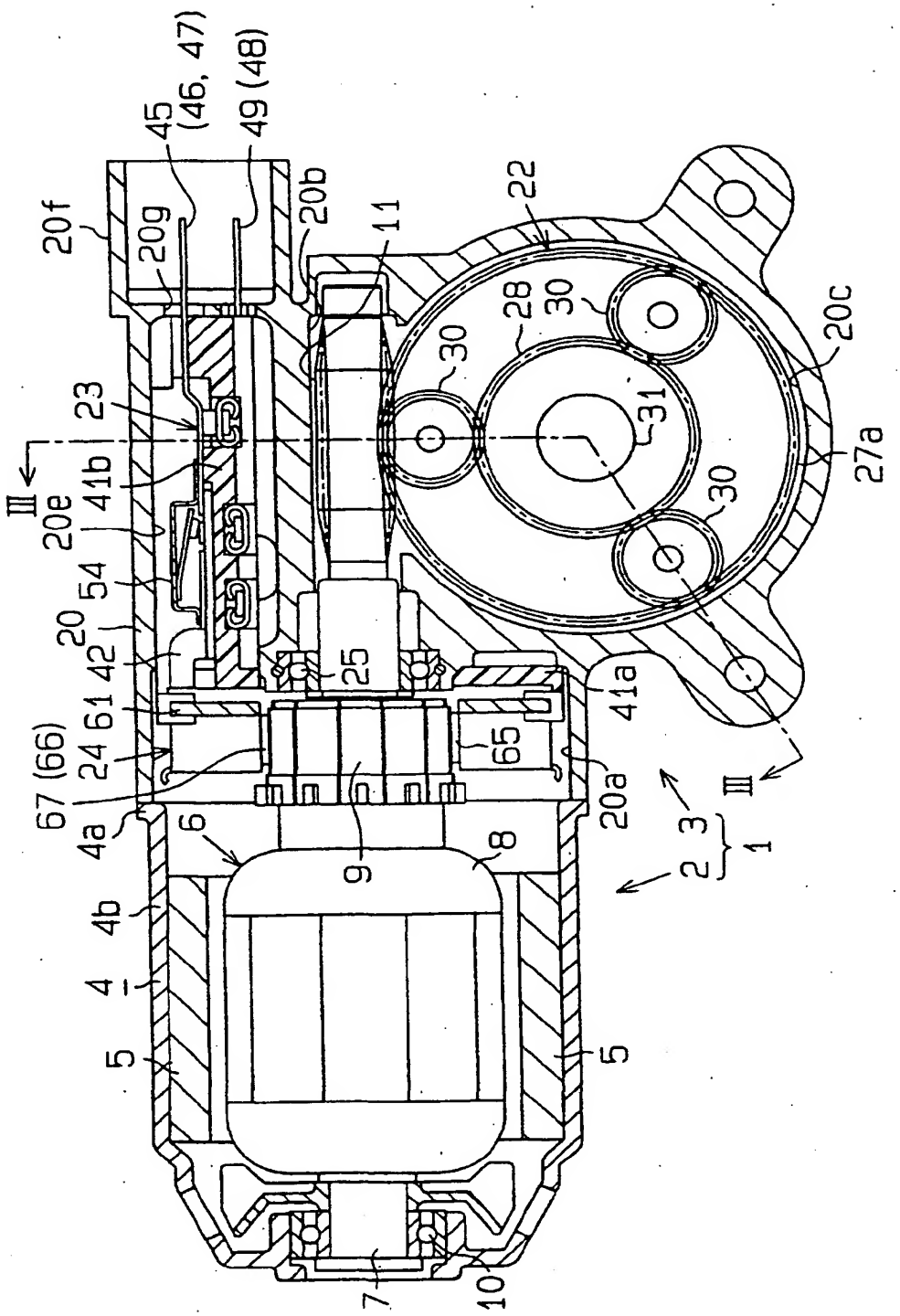
the flange (4a) of the yoke (4) is generally square-shaped in correspondence with the flange (20a) of the housing (20, 83, 88); and
the flange (4a) of the yoke (4) and the flange (20a) of the housing (20, 83, 88) are fixed to each other by a screw (N) passing through corners of the flanges (4a, 20a).

9. The motor device (1) as in claim 8, wherein:

the brush (61 - 65, 81, 82, 84 - 87) is disposed along the diagonal line defined by two corners of each of the flanges (4a, 20a); and
the screw (N) is provided in another two corners of each of the flanges (4a, 20a).

10. The motor device (1) as in any one of claims 6 to 9, further comprising:
a circuit unit (23) including capacitors and choke coils for electrical noise suppression and accommodated in the housing (20, 83, 88) at a position adjacent to the brush (65 - 67, 81, 82, 84 - 87) in the axial direction and opposite the reduction device (22) in the radial direction of the rotary shaft (7).

FIG. 1


45
(46, 47)
49 (48)
20f
20g
20b
11
22
28
30
20c
23
31
27a
III
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54
20
42
25
41a
61
24
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3
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4b
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10

FIG. 2

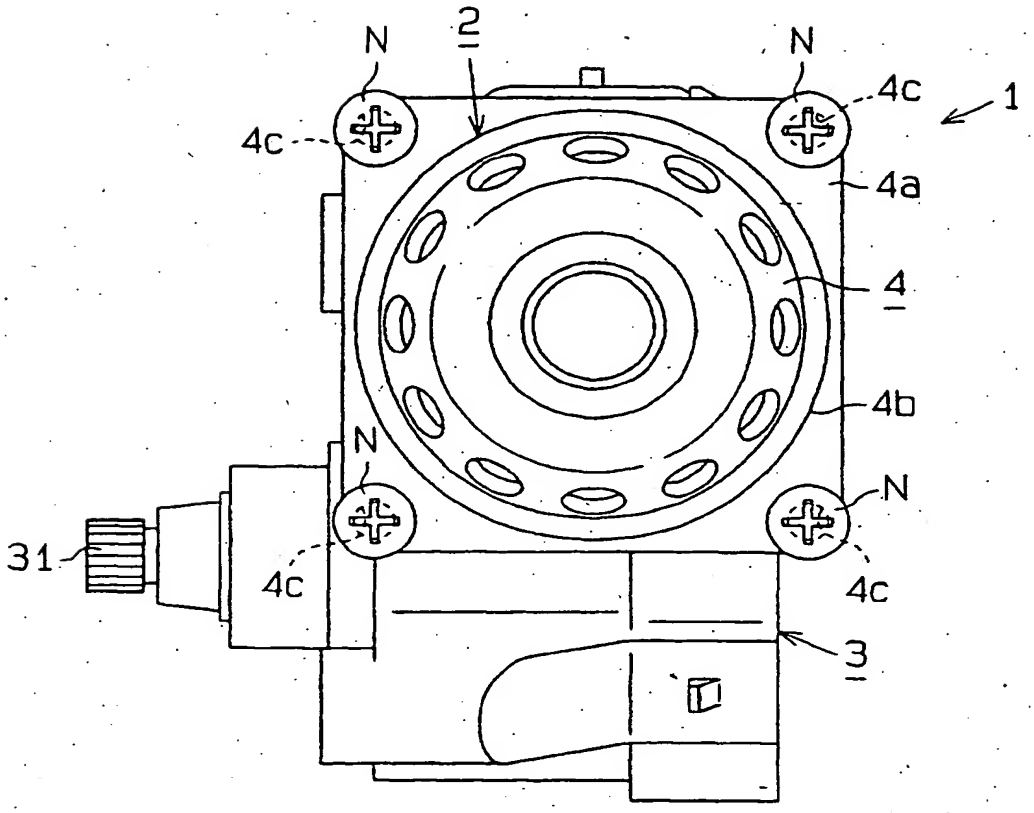

FIG. 3

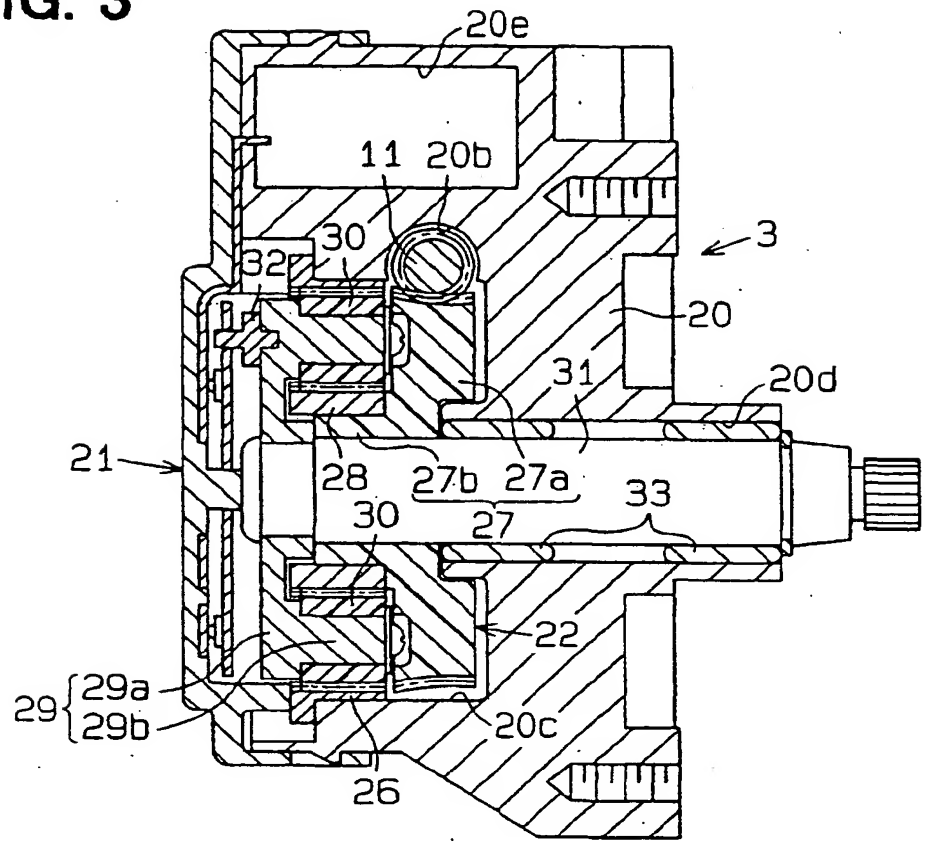

FIG. 4

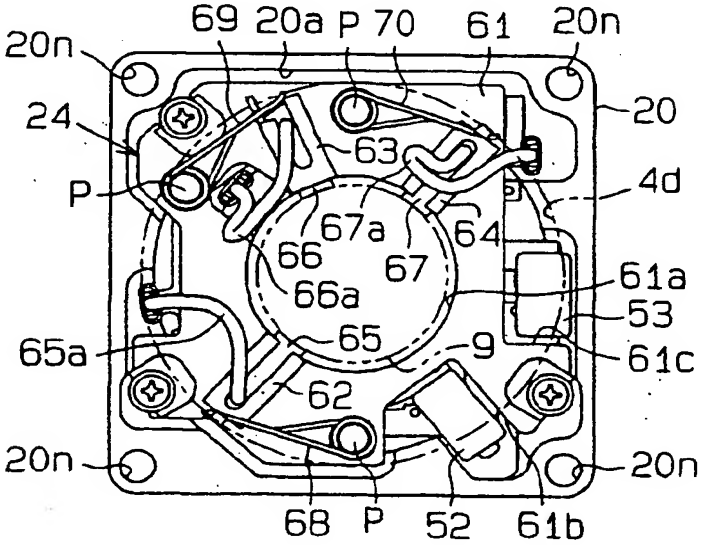

FIG. 5

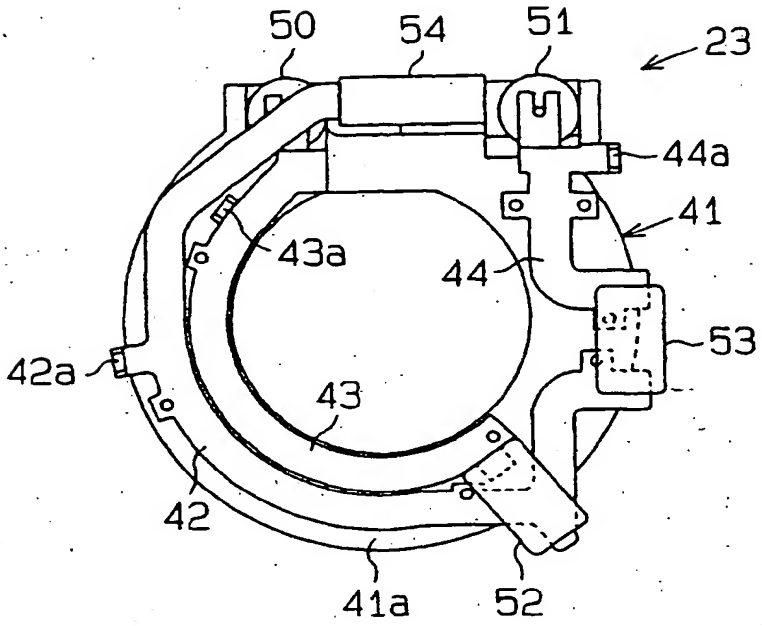

FIG. 6

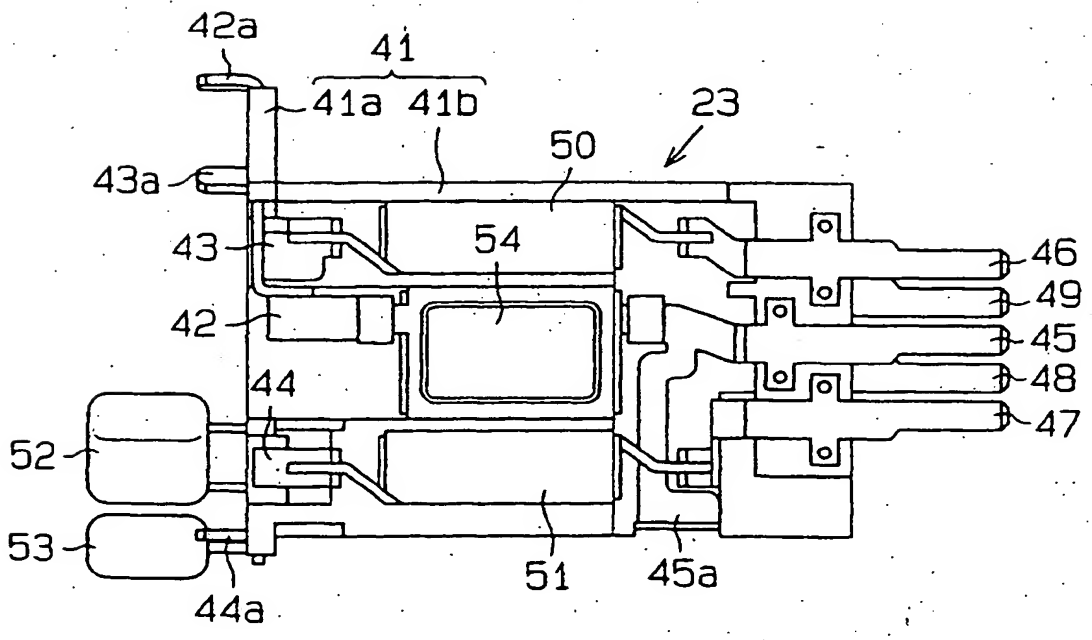

FIG. 7

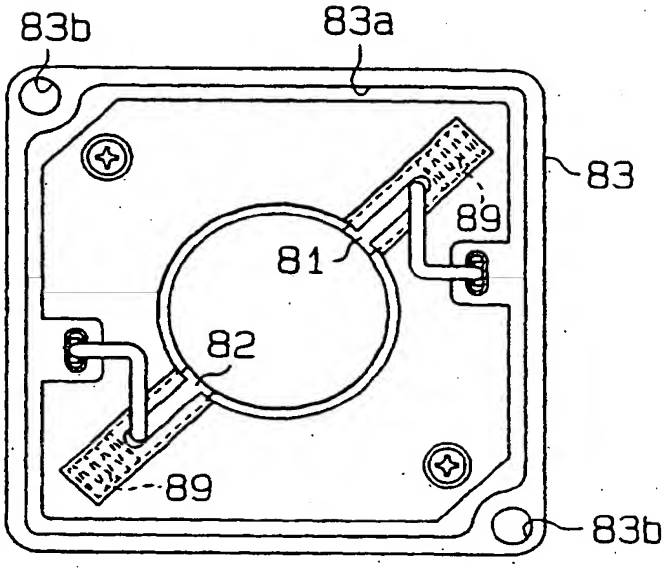

FIG. 8

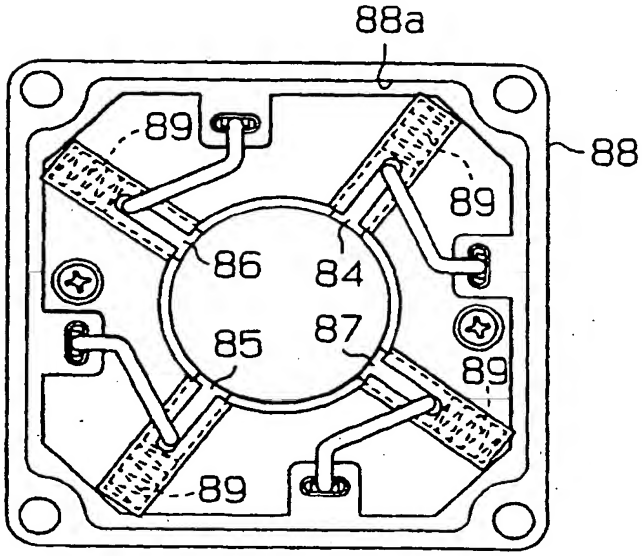

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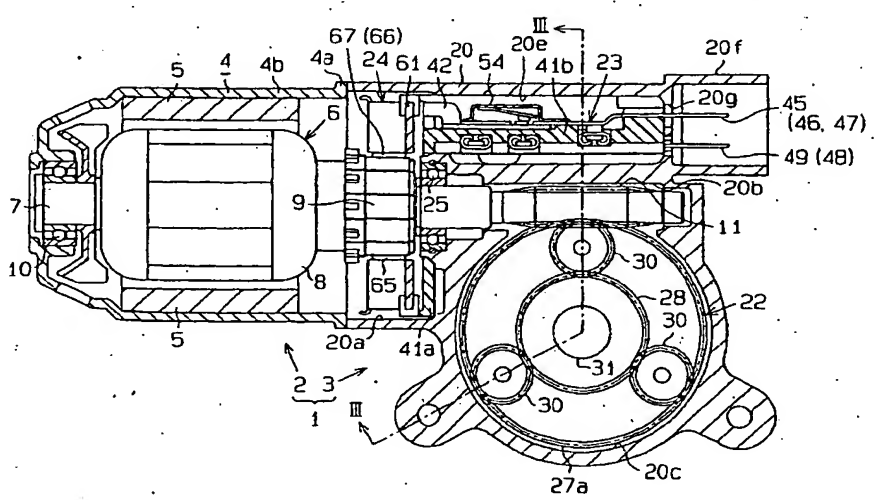
FIG. 1



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DOCUMENTS CONSIDERED TO BE RELEVANT

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The present search report has been drawn up for all claims

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